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The Not-So-Endless Ocean: How the Cost of Convenience is Closing in on Us

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The Not-So-Endless Ocean: How the Cost of Convenience is Closing In on Us

Rachel Emens[†]

Plastic garbage does not belong in the ocean any more than sharks belong in municipal swimming pools. Plastic is like an invasive species. Once established, it doesn't go away.

- Captain Charles Moore¹

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1. CHARLES MOORE WITH CASSANDRA PHILLIPS, PLASTIC OCEAN 118 (2011).

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I. INTRODUCTION

Releasing balloons into the sky to commemorate a special occasion, letting plastic cups get carried off by a summer breeze at a picnic, and tossing a cigarette butt out a car window because the ashtray is full. These items—all made up of, or containing, some form of plastic—do not just disappear into the wind. Every act of littering has an effect, no matter how symbolic, unintentional, or seemingly inconsequential. The ocean is no exception. Countless photographs depict marine and shore-dwelling animals caught in or choked by plastic debris, and ocean beaches devoid of washed-ashore plastic bottle caps and other trash are

anomalies. Trash covers coastal beaches worldwide. While marine debris—the result of littering, cargo ship spills, and tsunamis, among other reasons—has been a worldwide concern for a long time, the issue now deserves prompt, zealous attention more than ever before. Three examples demonstrate why.

First, the most recent harbinger demonstrating the gravity of the situation is washing ashore in Antarctica. Trash piles up at an astounding rate in Antarctica, a region once thought to be unscathed by humanity. In September 2012, the French non-profit organization, Tara Expeditions, unveiled some shocking news from its Tara Oceans study: Samples taken from the Southern Ocean and Antarctica yielded 50,000 fragments of plastic trash per square kilometer—about ten times the amount expected.² Chris Bowler, Tara Oceans' scientific coordinator, explained this figure was completely unexpected “because the Southern Ocean encircling Antarctica is relatively separated from the world's other oceans and does not normally mix with them”³; such far reaching pollution shows the true impact of humanity's footprint.

The second example derives from trash—buoys, Styrofoam, plastic cans—that continues to accumulate on the Pacific coast due to the March 2011 earthquake and tsunami in Japan.⁴ Following the tsunami, five million tons of trash was swept into the sea; although about 70 percent of that sunk near Japan, the rest dispersed throughout the North Pacific Ocean.⁵ Of that five million tons, British Columbia expects 1.5 million tons of that debris to eventually arrive on its shores.⁶ Though radioactive waste is unlikely to wash up, other potentially hazardous items and

2. Jennifer Walsh, *There Is 10 Times More Plastic in Antarctic Waters than We Thought*, BUSINESS INSIDER (Oct. 4, 2012, 3:35 PM), <http://www.businessinsider.com/lots-of-plastic-in-antarctic-waters-2012-10>; Zoe Holman, *Plastic Debris Reaches Southern Ocean, Previously Thought To Be Pristine*, THE GUARDIAN.CO.UK (Sep. 27, 2012, 2:00 PM), <http://www.guardian.co.uk/environment/2012/sep/27/plastic-debris-southern-ocean-pristine>. Additional information about Tara projects and expeditions can be found at <http://oceans.taraexpeditions.org/>.

3. Walsh, *supra* note 2; Holman, *supra* note 2.

4. See Dene Moore, *B.C. Planning Tsunami Cleanup as Japan, Canada Continue Funding Talks*, CANADIAN PRESS (Sept. 25, 2012, 4:12 PM), <http://www.theglobeandmail.com/news/british-columbia/bc-planning-tsunami-cleanup-as-japan-canada-continue-funding-talks/article4567748/>; see also Jake Ellison, *Northwest Voyage Discovers Japan Tsunami Debris Amid Second Wave*, SEATTLE P.I. (July 3, 2013, 6:20 PM), <http://www.seattlepi.com/local/article/NW-voyage-discovers-japan-tsunami-debris-amid-4646081.php>.

5. *Tsunami / Marine Debris on Washington Beaches*, WASH. STATE DEP'T. OF ECOLOGY, <http://marinedebris.wa.gov> (last visited Mar. 9, 2013).

6. *B.C. Expects 1.5-Million Tonnes of Tsunami Debris*, CBC NEWS (Sept. 25, 2012, 1:09 PM), <http://www.cbc.ca/news/canada/british-columbia/b-c-expects-1-5-million-tonnes-of-tsunami-debris-1.1166971>.

chemicals such as oil, Styrofoam, drums, and barrels, will.⁷ In British Columbia, viewers can already spot large blocks of Styrofoam from the air, with more debris visible as one gets closer.⁸ Cleanup crews with Gulf of Alaska Kepper, a nonprofit that conducted most beach cleanups along the Alaskan coast during the summer of 2013, have spotted animals eating, pecking at, and playing with the polystyrene (Styrofoam) bits that have drifted from Japan.⁹ The debris collected was 30 percent, by weight, Styrofoam, compared to 5 percent pre-tsunami debris.¹⁰ Styrofoam does not degrade in sunlight,¹¹ so unless it is collected, it will forever remain in the ocean as a hazard to aquatic and coastal wildlife.

Finally, while plastic debris in our seas is not a new concern, it is a growing problem—both literally and metaphorically. In the North Pacific Subtropical Convergence Zone, between Hawaii and California, lies what is known as the Great Pacific Garbage Patch (GPGP). And in the past forty years, it has grown 100-fold.¹² The GPGP, a swirling soup of mainly plastic garbage, is estimated to be twice the size of Texas, although at least one scientist has suggested that it is much smaller than this.¹³ Garbage patches provide an interesting case study, and will be described in more detail below.

These are but a few examples of where marine debris is taking a toll. This article does not discuss how to eliminate the garbage patches, or even how to clean up the oceans. Rather, this article seeks to explain and highlight various concerns surrounding plastics in the ocean. Part II of this article examines two prominent garbage patches, in order to explain how marine debris can cause an international dilemma. Part III examines plastics and issues raised by their existence in the oceans. Part IV summarizes governing laws and regulations. Part V analyzes the laws,

7. WASH. STATE DEP'T. OF ECOLOGY, *supra* note 5.

8. Mark Hume, *Tsunami Debris Litters B.C. Beaches*, GLOBE AND MAIL (Jan. 29, 2013, 8:37 PM), <http://www.theglobeandmail.com/news/british-columbia/tsunami-debris-litters-bc-beaches/article7934410/>.

9. Yereth Rosen, *Wave of Styrofoam From 2011 Tsunami Threatens Alaska Environment*, REUTERS (Jan. 30, 2013, 12:07 AM), <http://www.reuters.com/article/2013/01/30/us-usa-tsunami-styrofoam-idUSBRE90T06F20130130>.

10. *Id.*

11. *Id.*

12. Ian Johnston, *Study: Plastic in 'Great Pacific Garbage Patch' Increases 100-Fold*, NBCNEWS.COM (May 9, 2012, 6:02 AM), http://worldnews.nbcnews.com/_news/2012/05/09/11612593-study-plastic-in-great-pacific-garbage-patch-increases-100-fold?lite; see *infra* Part III B for a more in-depth discussion about the Great Pacific Garbage Patch and *infra* Part III A for a discussion about garbage patches generally.

13. Oceanic "Garbage Patch" Not Nearly as Big as Portrayed in Media, OR. STATE UNIV. (JAN. 4, 2011), <http://oregonstate.edu/ua/ncs/archives/2011/jan/oceanic-%E2%80%9Cgarbage-patch%E2%80%9D-not-nearly-big-portrayed-media>.

regulations, and efforts in place and how effective those efforts are. Finally, Part VI concludes with international, regional, local, and personal commitment suggestions about how to combat this widespread problem.

II. TALKING TRASH: AN ILLUSTRATION

A. Creation of Garbage Patches

There is a high incidence of plastic debris in convergence zones or ocean gyres.¹⁴ A gyre is a “circular ocean current formed by the Earth’s wind patterns and the forces created by the rotation of the planet. . . . Gyres circle huge areas in the middle of the ocean. Unlike coastal zones, these central regions are relatively stable; the ocean water does not circulate.”¹⁵ Due to the calm, stable water, and circular current, debris collects towards the center of the gyre and becomes trapped.¹⁶ The continual circular motion and current prevents the garbage from escaping.¹⁷ There are five major subtropical gyres.¹⁸ The North Pacific Subtropical Gyre, made up of four currents and covering seven to nine million square miles, tends to collect a large amount of debris.^{19 20}

Scholars call these areas of concentrated marine debris within the gyres “garbage patches.”²¹ Two garbage patches in the North Pacific Ocean exist: the western garbage patch and the eastern garbage patch. The western garbage patch consists of a concentration of debris off the coast of Japan and the Eastern garbage patch (which will be discussed further in the next section) consists of a concentration of debris between Hawaii and California.²² Similarly, a garbage patch exists in the Atlantic Ocean—the North Atlantic Gyre.²³ Garbage patches are not floating trash

14. Peter Kershaw, Saido Katsuhiko, Sangjin Lee, Jon Samseth, Doug Woodring & John Smith, *Plastic Debris in the Ocean*, UNEP YEAR BOOK: EMERGING ISSUES IN OUR GLOBAL ENVIRONMENT 21 (2011), http://www.unep.org/yearbook/2011/pdfs/UNEP_YEARBOOK_Fullreport.pdf.

15. *Ocean Gyre*, NAT’L GEOGRAPHIC, http://education.nationalgeographic.com/education/encyclopedia/ocean-gyre/?ar_a=1 (last visited Feb. 18, 2013).

16. *Great Pacific Garbage Patch*, NAT’L GEOGRAPHIC, http://education.nationalgeographic.com/education/encyclopedia/great-pacific-garbage-patch/?ar_a=3 (last visited Feb. 18, 2013).

17. *Id.*

18. *De-mystifying the “Great Pacific Garbage Patch,”* NAT’L OCEANIC AND ATMOSPHERIC ADMIN., <http://marinedebris.noaa.gov/info/patch.html#4> (last visited Feb. 18, 2013).

19. *Id.*

20. *Id.*

21. *What We Know About: The “Garbage Patches,”* NAT’L OCEANIC AND ATMOSPHERIC ADMIN., <http://marinedebris.noaa.gov/info/pdf/patch.pdf> (last visited Feb. 18, 2013).

22. *Id.*

23. NAT’L GEOGRAPHIC, *supra* note 16.

islands and they are not visible from satellite images;²⁴ their exact size and contents are not explicitly known.²⁵ But, researchers know the patches contain floatable marine debris from land and ocean based sources.²⁶ Plastic is the main type of debris found in the patches.²⁷

Plastics make up 90 percent of trash floating in oceans.²⁸ Plastics can drift for years before concentrating in a gyre.²⁹ Ten percent of the plastics produced each year end up in the ocean; 70 percent sinks, damaging ocean-floor life; and the rest floats.³⁰ Much of the floating trash forms in heaps that eventually wash up on distant shores.³¹ Many of the plastics do not wear down, but simply break up into tiny bits of plastics, called microplastics, which cannot be seen by the naked eye.³²

B. The Great Pacific Garbage Patch

The Eastern Pacific Garbage Patch is also known as the Great Pacific Garbage Patch (GPGP) and the Pacific Trash Vortex.³³ This particular patch was discovered by Captain Charles Moore in 1997.³⁴ In his recent book, Captain Moore recounts his discovery from that summer:

Let it be said straight up that what we came upon was *not* a mountain of trash, an island of trash, a raft of trash, or a swirling vortex of trash—all media-concocted embellishments of the truth. It would be come to be known as the Great Pacific Garbage Patch, a term that's had great utility but, again, suggests something other than what's out there. It was a thin plastic soup, a soup lightly seasoned with plastic flakes, bulked out here and there with "dumplings": buoys, net clumps, floats, crates, and other "macro debris." I was

24. *Id.*

25. NAT'L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 21.

26. *Id.*

27. NAT'L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 18.

28. *Marine Debris*, NATURAL RESOURCES COMMITTEE <http://democrats.naturalresources.house.gov/issue/marine-debris> (last visited Mar. 10, 2013).

29. *A Global Issue*, PLASTIC OCEANS, <http://www.plasticoceans.net/the-facts/a-global-issue/> (last visited Mar. 10, 2013).

30. *The Trash Vortex*, GREENPEACE, <http://www.greenpeace.org/international/en/campaigns/oceans/pollution/trash-vortex/> (last visited Mar. 10, 2013). See *infra* Part III C(3) for a discussion about ocean sediment.

31. Jacob Silverman, *Why Is the World's Biggest Landfill in the Pacific Ocean?*, HOWSTUFFWORKS, INC. (Sept. 19, 2007), <http://science.howstuffworks.com/environmental/earth/oceanography/great-pacific-garbage-patch.htm>.

32. NAT'L GEOGRAPHIC, *supra* note 16. See *infra* Part III B for a discussion about microplastics.

33. NAT'L GEOGRAPHIC, *supra* note 16.

34. *Id.*

not a latter-day Columbus discovering a plastic continent. I was a seafarer who noticed—at first incredulously, then with greater certainty—that the immense section of the northeastern Pacific Ocean, about halfway between Hawaii and the West Coast, was strewn throughout with buoyant plastic scraps.³⁵

While it is too large of an area for scientists to trawl the entire surface, 1.9 million plastic bits were collected in a single square mile of the GPGP.³⁶ In some areas, the debris is ninety feet deep and an estimated 80 percent of the litter in the GPGP comes from land.³⁷ It takes about six years for trash from North America to make it into the GPGP, and about a year for it to travel from Japan and other Asian countries.³⁸ Within the GPGP in 1999, the ratio of plastic to plankton was 6 to 1; in 2008, it was 46 to 1; in 2009, it was 26 to 1.³⁹ Because the GPGP is so far away from any country's coastline, no nation will take responsibility or will fund the cleanup of the GPGP.⁴⁰

III. THE PLASTIC PROBLEM

In the few decades it has been around, there is no denying that plastic has made our lives more convenient. Our foods stay fresher, our medicine can be packaged in child-safe bottles, our cars are lighter and more fuel-efficient, and our raincoats are waterproof. Plastic in its own right may be ubiquitous and useful, but convenience has costs to people, animals, and the planet.

A. A Peek Into the Plastic World: Use, Reuse & Disposal

Plastics are artificial or manmade chemical compounds⁴¹ made from a petroleum-based mix of polymers to which various other chemicals are added to enhance traits like suppleness and inflammability.⁴² Each component of a plastic product, for instance a baby bottle (made up of a rubbery nipple, plastic collar, and bottle base), could contain dozens of

35. MOORE, *supra* note 1, at 4.

36. NAT'L GEOGRAPHIC, *supra* note 16.

37. *The Great Pacific Garbage Patch*, OPRAH.COM (Apr. 22, 2009), <http://www.oprah.com/world/Ocean-Pollution-Fabien-Cousteaus-Warning-to-the-World/1>

38. NAT'L GEOGRAPHIC, *supra* note 16.

39. MOORE, *supra* note 1, at 324.

40. NAT'L GEOGRAPHIC, *supra* note 16. *See infra* Part IV for a summary of international laws, regulations, and initiatives that have been adopted by some parts of the world.

41. *What We Know About: Plastic Marine Debris*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., <http://marinedebris.noaa.gov/info/pdf/plastic.pdf> (last visited Mar. 9, 2013).

42. Susan Casey, *Our Oceans Are Turning Into Plastic . . . Are You?*, MEN'S HEALTH, <http://www.menshealth.com/best-life/water-pollution?fullpage=true> (last visited June 3, 2014).

chemicals that have not been required to be disclosed due to trade secret protection.⁴³ A few common examples of plastics and their uses include the following: soda bottles made from polyethylene terephthalate (PET); plastic bags made from polyethylene (PE); drinking straws and bottle caps made from polypropylene (PP); detergent bottles made from high-density polyethylene (HDPE); and take-out food containers made from polystyrene (PS).⁴⁴ The varying properties of the types of plastics have an impact on the particular plastic item's fate in the ocean.⁴⁵ For instance, PE and PP tend to be buoyant, whereas PS and PET tend to sink.⁴⁶ Since 1976, "plastic has been the most used material in the world." Current estimates indicate that 300 million tons of plastic are produced each year worldwide.⁴⁷ Use of plastic in North America and Western Europe is expected to increase to 140 kg (nearly 309 pounds) per capita (up from 100 kg, or approximately 220 pounds, in 2005).⁴⁸ Use of plastics in rapidly-developing-Asian countries is also expected to increase from 20 kg to 36 kg by 2015.⁴⁹

Rates of recycling and reuse vary greatly. This is based on a mix of factors: poor waste management, inadequate policies, ineffective enforcement, and individuals' attitude and behavior.⁵⁰ In 2009, seven EU countries, Norway, and Switzerland, recovered more than 84 percent of plastics for recycling or reuse, whereas several other European countries were able to recover 25 percent or less.⁵¹ In the United States, only 8 percent, or 2.4 million tons, of total plastic waste generated was recovered for recycling in 2010.⁵² Some plastics, however, have a much higher rate of recycling. That same year, 2010, 28 percent of HDPE bottles and 29 percent of PET bottles and jars were recycled,⁵³ and the recycling rate of plastic films (plastic bags, sacks, and wraps) was only about 4 percent.⁵⁴

43. MOORE, *supra* note 1, at 241

44. NAT'L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 41.

45. Kershaw et al., *supra* 14, at 22.

46. *Id.*

47. MOORE, *supra* note 1, at 41.

48. Kershaw et al., *supra* note 14, at 21.

49. Kershaw et al., *supra* note 14, at 22.

50. *Id.*

51. *Id.*

52. *Plastics*, U.S. ENVTL. PROT. AGENCY, <http://www.epa.gov/osw/conserves/materials/plastics.htm> (last updated Nov. 19, 2012).

53. *Id.*

54. THURSTON CNTY. PUB. WORKS DEP'T, *Recycling and Reuse Information*, SOLID WASTE PROGRAM, <http://www.co.thurston.wa.us/solidwaste/recycling/recycling-plastics.htm> (last visited Mar. 9, 2013).

Even individuals who think they are recycling their plastic bags may be in for a surprise. For instance, in Washington (a considerably green-minded state), the majority of recycling facilities lack the ability to recycle plastic bags, and employees often spend time removing bags, which get tangled up in the machines, and throwing them away.⁵⁵ In California, the recycling rate for bottles and cans is 82 percent, whereas Mississippi's rate is only 13 percent.⁵⁶ Furthermore, the collecting and recycling of mixed plastics is challenging and expensive, and manufacturers do not have incentives to use recycled plastics.⁵⁷

B. A (Microscopic) Look at Microplastics

1. The Breakdown

Microplastics are any plastic solids smaller than five millimeters.⁵⁸ Some microplastics are the result of large pieces breaking down into smaller and smaller pieces.⁵⁹ This is because full degradation of the most common plastics generally does not occur.⁶⁰ Because the ocean is a cold, dark place, degradation of plastic occurs slower than it would in a landfill; also, biodegradable plastics that break down in a compost pile or landfill do not generally degrade as quickly in the ocean.⁶¹ However, when the plastics do begin to degrade, they are leaching potentially toxic chemicals, such as BPA, into the ocean.⁶²

The study of microplastics is a field in its infancy, according to the Center for Urban Waters (CUW) in Tacoma, Washington.⁶³ What is known, however, is that microplastics are pervasive. Dr. Joel Baker, Science Director of the CUW, says, "Initial findings suggest that microplastics, like DDT and other 'persistent pollutants,' do not

55. Josh Feit, *Report: Plastic-Bag Recycling Doesn't Work*, SEATTLE MET (Feb. 14, 2012, 12:00 PM) <http://www.seattlemet.com/news-and-profiles/publicola/articles/report-plastic-bag-recycling-doesnt-work>.

56. MOORE, *supra* note 1, at 315.

57. *Recycling Plastic: Complications & Limitations*, EUREKA! RECYCLING (Apr. 2009), http://plasticbaglaws.org/wordpress/wp-content/uploads/2010/04/industry_Eureka-Recycling-newsletter-re-plastic-recycling.pdf.

58. *Sources and Distribution of Marine Microplastics*, CTR. FOR URBAN WATERS, <http://www.urbanwaters.org/sources-and-distribution-marine-microplastics> (last visited Mar. 10, 2013).

59. NAT'L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 41.

60. *Id.*

61. *Id.*

62. Carolyn Barry, *Plastic Breaks Down in Ocean After All—and Fast*, NAT'L GEOGRAPHIC NEWS (Aug. 20, 2009), <http://news.nationalgeographic.com/news/2009/08/090820-plastic-decomposes-oceans-seas.html>.

63. CTR. FOR URBAN WATERS, *supra* note 58.

completely break down in the environment.”⁶⁴ There is growing concern about the potential impact of plastic debris’ release of persistent bio-accumulating and toxic compounds (PBTs).⁶⁵ This is because plastics can emit toxic chemicals while drifting in sunlight and salty water.⁶⁶ Over time, persistent, bio-accumulating PBTs are absorbed by the small plastic debris and then are released.⁶⁷ These PBTs include polychlorinated biphenyls (PCBs), which were banned both in the United States in 1979 and internationally in 2001,⁶⁸ as well as polyaromatic hydrocarbons (PAHs), hexachlorocyclohexane (HCH), the insecticide DDT, and others.⁶⁹ PCBs accumulate on plastic because of plastic’s “molecular tendency to attract oils.”⁷⁰ PBTs contribute to health effects such as endocrine disruption, mutagenicity, and carcinogenicity.⁷¹

A subcategory of PBTs, called persistent organic pollutants (POPs), are currently regulated under the Stockholm Convention on Persistent Organic Pollutants.⁷² POPs are toxic chemicals that adversely affect human health and the environment.⁷³ One such POP, DDT, a pesticide, was banned in the United States in 1972, but continues to be used for mosquito abatement in some parts of the world.⁷⁴ Others include polychlorinated biphenyls (PCBs), which have been used in various industrial capacities, such as in electrical transformers, hydraulic and heat exchange fluids, and additives to paints and lubricants.⁷⁵ Dr. Baker adds, “What is more, plastic particles in the ocean appear to have the capacity to absorb and desorb organic chemicals.”⁷⁶

Plastics can also leach those potentially toxic chemical additives from the manufacturing of the particular plastic object chemicals, such as bisphenol A (BPA), styrene monomer, nonylphenol, and phthalates.⁷⁷ These chemicals have been shown to have adverse health effects such as

64. Fritz Satir, *Microplastic=Microproblem*, U. OF WASH., TACOMA, <http://www.tacoma.uw.edu/features/research/microplastic-macroproblem> (last visited Mar. 10, 2013).

65. Kershaw et al., *supra* note 14, at 21.

66. Walsh, *supra* note 1.

67. Kershaw et al., *supra* note 14, at 25-26.

68. NAT’L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 21.

69. Kershaw et al., *supra* note 14, at 26.

70. Casey, *supra* note 42, at 108.

71. Kershaw et al., *supra* note 14, at 21.

72. *Id.*

73. *Persistent Organic Pollutants: A Global Issue, A Global Response*, U.S. ENVTL. PROT. AGENCY, <http://www.epa.gov/international/toxics/pop.html> (last updated July 30, 2012).

74. *DDT Ban Takes Effect*, U.S. ENVTL. PROT. AGENCY (Dec. 31, 1972), <http://www.epa.gov/history/topics/ddt/01.html>.

75. U.S. ENVTL. PROT. AGENCY, *supra* note 73.

76. Satir, *supra* note 64.

77. Kershaw et al., *supra* note 14, 26.

disruption to the endocrine system's ability to regulate hormones.⁷⁸ BPA has been shown to interfere with reproductive systems, and styrene monomer is suspected to be a carcinogen.⁷⁹ The toxins accumulate in organisms' tissue and then move up the food chain as those animals are consumed.⁸⁰ Alarming, we humans may consume those animals.

POPs and contaminated organisms can travel great distances to new, remote homes.⁸¹ In the Southern Ocean, where plastic particles have begun appearing, the vulnerability is even higher because "it is the last big area where nonindigenous animal species are not yet known to be established"; furthermore, the recent warming of surface waters makes the foreign organisms' chances of survival and establishment more likely.⁸²

2. Nurdles: What They Are and What They Can Tell Us

Another type of microplastic is a preproduction plastic pellet, or "nurdle."⁸³ Nurdles are pellets the size of grains of rice that are later molded into plastic products of various uses.⁸⁴ These pellets have ended up in the ocean accidentally because of poor handling and waste management.⁸⁵ When pellets are carelessly unloaded from the trains that transport them, the spilled pellets can land in storm drains, through the watershed, and into the ocean.⁸⁶ While there has been some improvement in the number of pellets being introduced into the ocean due to improved industrial practices, the "pellets already released will persist for many years."⁸⁷ Furthermore, spills continue to happen, even if by "an act of God," such as a tsunami. For instance, in July 2012, during Typhoon Vicente, a Chinese shipping vessel spilled at least 150 tons of nurdles off Lamma Island.⁸⁸ Despite thousands of volunteers working to clean up

78. *Id.*

79. Barry, *supra* note 62.

80. *Plastic Debris Washed Ashore*, ALGALITA MARINE RESEARCH FOUND., <http://www.algalita.org/pdf/plastic-in-the-environment.pdf> (last visited Mar. 9, 2013).

81. David K.A. Barnes, Adam Walters & Leandra Goncalvez, *Macroplastics at Sea Around Antarctica*, 70 MARINE ENVTL. RES. 250, 250 (2010).

82. *Id.* at 251.

83. MOORE, *supra* note 1, at 50-51.

84. ALGALITA MARINE RESEARCH FOUND., *supra* note 80.

85. Kershaw et al., *supra* note 14, at 27.

86. ALGALITA MARINE RESEARCH FOUND., *supra* note 80.

87. Kershaw et al., *supra* note 14, at 27.

88. Mary Ann Benitez, 'Plastic Ocean' Captain To Pile On Pellets Pressure, THE STANDARD (Sept. 4, 2012), http://www.thestandard.com.hk/news_detail.asp?we_cat=4&art_id=126084&sid=37541634&con_type=1&d_str=20120904&fc=2.

Hong Kong's beaches,⁸⁹ only 60 percent of the pellets had been reclaimed six months after the spill.⁹⁰ Delayed government action has affected the fishing industry's public image and its sales⁹¹ because some of the pellets have been found in the guts of fish from Hong Kong fish farms, which sparked concern about the safety of consuming these fish.⁹² Sinopec, the major Chinese oil company that owned the pellets, although not taking legal responsibility for the spill, has set aside \$1.29 million to pay for the cleanup and dispatched its staff to join the volunteers collecting the pellets by hand.⁹³

Nurdles aggressively attract and adsorb POPs from polluted seawater, according to a 2001 paper by Tokyo University's Professor Hideshige Takada.⁹⁴ Dr. Takada's project, International Pellet Watch (IPW), attempts to understand the current status of global POP pollution.⁹⁵ In 2010, volunteers in twenty-three countries gathered pellets from fifty-one coastal sites and mailed them to IPW.⁹⁶ The results showed that the more populous and industrial the surrounding community, the higher the rate of toxins in pellets.⁹⁷

The nurdles' consistent size makes them good pollution-monitoring tools.⁹⁸ The older pellets have higher concentrations of contaminants and have been used to map the distribution of pollution across the globe.⁹⁹ The concentrations of PCBs in the beached nurdles were lowest in those collected in the United States, Western Europe, and Japan.¹⁰⁰ Of the two dominant types of pellets—PE and PP—the PE pellets, which is the most abundant type of plastic, were the most contaminated.¹⁰¹ The sample pellets taken from the Great Pacific Garbage Patch contained the highest levels of nonylphenols, “a chemical cousin to BPA most commonly used as a surfactant in detergents and pesticides, but also as a plasticizer and

89. Martin Williams, *Pellets Spill During Typhoon Sparked Big Volunteer Clean-Up on Hong Kong Beaches*, S. CHINA MORNING POST (Aug. 19, 2012), <http://www.scmp.com/news/hong-kong/article/1018034/pellets-spill-during-typhoon-sparked-big-volunteer-clean-hong-kong>.

90. Benitez, *supra* note 88.

91. *Id.*

92. AFP, *Oil Giant To Pay for Hong Kong Nurdle Spill*, DISCOVERY NEWS (Aug. 9, 2012 3:00 AM), <http://news.discovery.com/earth/hong-kong-nurdles-cleanup-120809.html>.

93. *Id.*

94. MOORE, *supra* note 1, at 240-241.

95. See INT'L PELLET WATCH, <http://www.pelletwatch.org> (last visited Mar. 10, 2013).

96. MOORE, *supra* note 1, at 241-242.

97. *Id.* at 242.

98. Kershaw et al., *supra* note 14, at 27.

99. *Id.*

100. *Id.*

101. MOORE, *supra* note 1, at 242.

antioxidant in plastics”¹⁰² and decabrominated diphenyl ether (BDE209), a flame retardant “now shown to break into smaller, more toxic segments.”¹⁰³ Aside from the toxic chemicals that are released from the breakdown of plastic, animals are consuming plastics that have acted like chemical sponges.¹⁰⁴ The pollutants can then become more concentrated as animals consume their contaminated prey.¹⁰⁵ Taken to its logical end, we, at the top of the food chain, might be consuming these animals and chemicals every day.

3. The Truth About Microscrubbers

Another contributor to the microplastics problem is the cosmetic industry. Microscrubbers in some brands of face and body washes (such as Oil of Olay, Dove, and Clean & Clear) are made from polyethylene beads the size of a grain of sand.¹⁰⁶ “Exfoliating” microplastic beads are also used in industrial settings¹⁰⁷ such as in abrasives and cleaning compounds.¹⁰⁸ “[S]ewage treatment systems are not designed to remove microplastics” that get flushed down the drain, so the particles end up in the watersheds and the ocean.¹⁰⁹ Animals such as mussels, barnacles, and tiny crustaceans mistake the beads for zooplankton, and the particles may remain in their digestive tracts or migrate into their body tissue.¹¹⁰ This goes up the food chain, causing a lot of animals (e.g., otters, octopi, whales, etc.) to end up with large amounts of plastic in their bodies; the plastic cannot be digested, so it ends up stopping their tissues from functioning properly and they die.¹¹¹

C. Getting to the Bottom of It: What’s Wrong with Ocean Sediment?

The problem of plastic pollution does not stay on the surface, where some of the plastics float. Some plastics (PP and PE) floating on the

102. MOORE, *supra* note 1, at 267.

103. *Id.* at 268.

104. Barry, *supra* note 62.

105. *Id.*

106. Julia Layton, *Are My Bath Habits Destroying Marine Ecology?*, HOWSTUFFWORKS, INC. (Dec. 9, 2008), <http://science.howstuffworks.com/environmental/green-science/bath-habit-marine-ecology.htm>.

107. Phuong Le, *Emerging Ocean Concern: Tiny Plastic Particles*, U.S. NEWS (June 14, 2010), <http://www.usnews.com/science/articles/2010/06/14/emerging-ocean-concern-tiny-plastic-particles>.

108. MOORE, *supra* note 1, at 289.

109. Hillary Rosner, *Scrubbing Out Sea Life*, SLATE (June 16, 2008, 2:45 PM), http://www.slate.com/articles/business/moneybox/2008/06/scrubbing_out_sea_life.single.html.

110. *Id.*

111. Layton, *supra* note 106.

ocean's surface will break down due to UV radiation and begin to sink to the seabed.¹¹² Other plastics are quickly fouled in seawater (due to the growth of bacteria, algae, barnacles, shellfish, etc.), and, thus, the biological layer might affect the breakdown of the object or increase its density, causing it to sink.¹¹³ Again, 70 percent of plastic sinks and damages ocean-floor life.¹¹⁴ This is significant considering about 90 percent of ocean species spend some or all of their lives in or on bottom sediments.¹¹⁵ In the past, ocean sediments have been contaminated by pollutants such as DDT, PCBs, and others that enter the waters every day.¹¹⁶ Pollutants contaminating today's sediment are from sources such as industrial and municipal waste dischargers, polluted runoff from urban and agricultural areas, and contaminants travelling through the air and water from distant producers.¹¹⁷ For instance, microplastic fragments have been found in places as remote as the island of South Georgia in the Southern Ocean,¹¹⁸ where there is no permanent human population.¹¹⁹

In 2008, a study to determine the causes of the POP contamination found in such species as dolphins and narwhals as well as sperm, beaked, and killer whales was conducted by the National Oceanic and Atmospheric Administration (NOAA) and Virginia Institute of Marine Science.¹²⁰ These animals tend to eat deep and bottom-dwelling creatures (octopi, squids, cuttlefish, etc.).¹²¹ The study found that there were measurable and sometimes high levels of toxic pollutants, such as PCBs, DDTs, and brominated flame retardants, which are most often associated with plastics.¹²² The EPA warns: "Animals that survive exposure to contaminated sediments may develop serious health problems, including fin rot, tumors, and reproductive effects. . . . Possible long-term effects of eating contaminated fish include cancer and neurological defects."¹²³

112. Kershaw et al., *supra* note 14, at 26.

113. *Id.*

114. GREENPEACE, *supra* note 30.

115. MOORE, *supra* note 1, at 244.

116. *Water: Contaminated Sediments*, U.S. ENVTL. PROT. AGENCY, <http://water.epa.gov/polwaste/sediments/cs/aboutcs.cfm> (last visited Mar. 9, 2013).

117. *Id.*

118. Barnes et al., *supra* note 81, at 252.

119. *Frequently Asked Questions*, S. GA. & S. SANDWICH IS., http://www.sgisland.gs/index.php/%28h%29Frequently_Asked_Questions?useskin= (last visited Mar. 10, 2013).

120. MOORE, *supra* note 1, at 244-245.

121. *Id.*

122. *Id.*

123. U.S. ENVTL. PROT. AGENCY, *supra* note 116.

D. Plastic's Impact on Marine Animals

As has been intimated, plastic in the form of ocean debris is problematic in the animal kingdom for a number of reasons. First, plastic is often mistaken for food and eaten by wildlife.¹²⁴ For instance, loggerhead sea turtles mistake plastic bags for jellyfish,¹²⁵ and Laysan albatross consume red disposable lighters and bottle caps likely because they resemble squid.¹²⁶ If the plastic that a fish eats stays in its gut rather than passing through, the fish will feel full, leading to the possible malnutrition or starvation of that fish.¹²⁷ Furthermore, plastic ingestion does not end with fish, reptiles, and birds—plastics are found in every size marine creature, from filter feeders to whales.¹²⁸ For example, a United Kingdom study revealed plastic as a contributing factor in whale beachings at least 50 percent of the time.¹²⁹

Aside from ingestion, plastics can provide hazards for animals, such as a monk seal trapped in ghost netting;¹³⁰ a marine bird entangled by a plastic six-pack holder;¹³¹ or a sea turtle with a plastic band stuck around it, causing the shell to morph into an hourglass shape.¹³² The numbers are alarming: “More than a million seabirds, 100,000 marine mammals, and countless fish die in the North Pacific each year” from ingestion or ensnaring leading to drowning.¹³³

In addition, the floating plastic is creating new habitats and disrupting existing ones. For example, “sea skaters” (*Halobates sericeus*), marine insects that usually lay eggs on floating objects such as seashells, lumps of tar, and seabird feathers, have begun also laying eggs on plastics floating in the GPGP. Further, due to the influx of new plastic surfaces, there has been an increase in the number of eggs laid.¹³⁴ The implication spans further than just an increase in a particular kind of insect: “[P]lastic-induced changes in [the sea skater] population structure

124. Walsh, *supra* note 2.

125. NAT'L GEOGRAPHIC, *supra* note 16.

126. MOORE, *supra* note 1, at 123.

127. NAT'L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 41.

128. MOORE, *supra* note 1, at 223-224.

129. Layton, *supra* note 106.

130. MOORE, *supra* note 1, at photograph insert (photograph taken by [Cynthia Vanderlip]).

131. NAT'L GEOGRAPHIC, *supra* note 16.

132. Casey, *supra* note 42, at 105.

133. *Id.*

134. Mario Aguilera, *Plastic Trash Altering Ocean Habitats, Scripps Study Shows*, UC SAN DIEGO NEWS CENTER (May 8, 2012), http://ucsdnews.ucsd.edu/pressreleases/plastic_trash_altering_ocean_habitats_scripps_study_shows.

could have ecosystem-wide consequences.”¹³⁵ Furthermore, the plastics provide temporary habitats for invasive species such as sessile invertebrates, seaweeds, and pathogens.¹³⁶ The plastic is also disrupting habitats and food webs by blocking sunlight from reaching plankton and algae below.¹³⁷ If the animals who feed on algae and plankton, such as fish and turtles, start to die off because the food is scarce, hunger will continue up the food chain.¹³⁸

Humans may be at the top of the food chain, but that does not mean we are invulnerable to what happens at the bottom. Plastics, while serving so many useful purposes for humans, are not as innocuous as they may seem.

E. Problem Solving

As discussed above, because thoroughly cleaning up the oceans is not feasible, and because shore clean-up is an ongoing need, we need to focus our efforts on what we can do going forward. Oceanographer Curtis Ebbesmeyer, who coined the term “Great Pacific Garbage Patch,” explains it this way: “We can’t clean it up. It’s just too big. You’d have the entire U.S. Navy out there, round the clock, continuously towing little nets. And it’s produced so fast, they wouldn’t be able to keep up.”¹³⁹ Furthermore, even if there was a net designed to sift out the trash, much of the debris is the same size as small sea animals, so those creatures might be scooped up as well.¹⁴⁰ Therefore, this article focuses not on how to go about cleaning up the ocean, or even the shores, but instead calls for international, regional, local, and personal changes to use, reuse, and disposal of plastics.

With nudrles, microscrubbers, and photodegraded plastics added to the trash pile, it becomes even clearer that dredging the surface of the ocean to remove the macroplastics and their invasive cousins, microplastics, will not correct the problem. And, with an incomprehensible numbers of toxic particles sinking to unreachable depths, the plastic problem has expanded from the visible to the invisible—from bad to much worse.

135. Miriam C. Goldstein, Marci Rosenberg & Lanna Cheng, *Increased Oceanic Microplastic Debris Enhances Oviposition in an Endemic Pelagic Insect*, BIOLOGY LETTERS (May 9, 2012), available at <http://rsbl.royalsocietypublishing.org/content/early/2012/05/10/rsbl.2012.0298.full.pdf+html>.

136. Kershaw et al., *supra* note 14, at 25.

137. NAT’L GEOGRAPHIC, *supra* note 16.

138. *Id.*

139. Johnston, *supra* note 12.

140. NAT’L GEOGRAPHIC, *supra* note 16.

IV. TRASH LAWS AND REGULATIONS

Because an ocean cannot be owned by any one nation or state, the responsibility for its care is difficult to assign. Ocean pollution is a global problem, requiring global attention. This section briefly describes the main international laws and regulations, as well as highlights the main initiatives and laws that have been codified in the United States.

A. International Laws/Regulations

The UN states that while discharges of plastic and other litter from ships and offshore structures are addressed under international law, “implementation and enforcement are often inadequate.”¹⁴¹ The two major international conventions that specifically address marine litter are (1) the 1973 International Convention for the Prevention of Pollution from Ships, as modified by the Protocol of 1978 (MARPOL 73/78), and (2) the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972.¹⁴² This latter Convention is commonly referred to as the “London Convention,” and its 1996 Protocol is referred to as the “London Protocol.”¹⁴³ But these two conventions do not address nor correct all concerns: “The coverage of these conventions in general is considered to be adequate, but their implementation and enforcement may need to be strengthened.”¹⁴⁴ In the United States, the Environmental Protection Agency (EPA) implements the treaties and international agreements geared at preventing and reducing marine debris via domestic laws and regulations.¹⁴⁵

1. MARPOL

MARPOL’s regulations are aimed at the prevention and minimization of accidental and routine pollution from ships.¹⁴⁶ Six technical “Annexes” regulate and control particular discharges.¹⁴⁷ Annex V, which became effective in December 1988, specifically regulates the prevention of pollution by garbage from ships, and imposes a ban of the

141. Kershaw et al., *supra* note 14, at 22.

142. *Id.* at 29.

143. *Id.*

144. *Id.*

145. *Water: Marine Debris*, U.S. ENVTL. PROT. AGENCY, <http://water.epa.gov/type/oceb/marinedebris/lawsregs.cfm> (last visited Mar. 9, 2013).

146. *International Convention for the Prevention of Pollution from Ships (MARPOL)*, INT’L MAR. ORG., [http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-\(MARPOL\).aspx](http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx) (last visited Mar. 10, 2013).

147. *Id.*

disposal of all forms of plastics into the ocean.¹⁴⁸ In the United States, vessels must maintain garbage record books and management plans and display for vessel crews and passengers the requirements of MARPOL Annex V; violations are subject to fines or imprisonment.¹⁴⁹ In July 2011, International Maritime Organization (IMO) adopted amendments, such as the prohibition of *all* garbage into the sea, which took effect beginning January 1, 2013.¹⁵⁰ IMO also has been encouraging governments to improve the garbage reception facilities at ports and terminals.¹⁵¹ For instance, litter-reduction efforts can be more effective with adequate and inexpensive reception facilities.¹⁵²

2. The London Convention

The London Convention covers the disposal of garbage generated on land by putting it into the sea.¹⁵³ The London Convention has eighty-seven states as signatories¹⁵⁴ that agree to refrain from dumping into the sea “persistent and other non-biodegradable materials, as well as certain compounds.”¹⁵⁵ The 1996 London Protocol, which currently has forty-two parties to it,¹⁵⁶ was put in place to modernize, and eventually replace, the Convention; the Protocol prohibits all wastes except for “possibly acceptable wastes” on its “reverse list” (dredged material, sewage sludge, fish wastes, vessels and platforms, etc.).¹⁵⁷ The Protocol is more restrictive in terms of garbage that can be dumped into the sea because it implies that all dumping is prohibited unless explicitly permitted.¹⁵⁸

148. *Id.*

149. Kershaw et al., *supra* note 14, at 29.

150. *Prevention of Pollution by Garbage from Ships*, INT’L MAR. ORG., <http://www.imo.org/ourwork/environment/pollutionprevention/garbage/Pages/Default.aspx> (last visited Mar. 10, 2013).

151. Kershaw et al., *supra* note 14, at 29.

152. *Id.* at 30.

153. *Id.* at 29.

154. *London Convention and Protocol*, INT’L MAR. ORG., <http://www.imo.org/OurWork/Environment/SpecialProgrammesAndInitiatives/Pages/London-Convention-and-Protocol.aspx> (last visited Mar. 10, 2013).

155. Kershaw et al., *supra* note 14, at 29.

156. INT’L MAR. ORG., *supra* note 154.

157. *The London Convention and Protocol: Their Role and Contribution to Protection of the Marine Environment*, INT’L MAR. ORG., <http://www.imo.org/OurWork/Environment/SpecialProgrammesAndInitiatives/Pages/London-Convention-and-Protocol.aspx> (follow hyperlink of “English” to access brochure) (last visited Mar. 10, 2013).

158. *Frequently Asked Questions*, INT’L MAR. ORG., <http://www.imo.org/OurWork/Environment/SpecialProgrammesAndInitiatives/Pages/London-Convention-and-Protocol.aspx> (follow hyperlink for “FAQ” on main page) (last visited Mar. 10, 2013).

3. UN Initiatives

Another international effort is the United Nations Convention on the Law of the Sea (UNCLOS).¹⁵⁹ UNCLOS, which came into force in November 1994, is an international treaty providing a regulatory framework for the use of the world's seas and oceans and addressing sovereignty, maritime zone usage, and navigational rights.¹⁶⁰ As of November 15, 2010, UNCLOS had 160 member States.¹⁶¹ Part XII of the Convention concerns the Protection and Preservation of the Marine Environment and:

[S]ets out general obligations to prevent, reduce and control pollution from land-based sources, including rivers, estuaries, pipelines and outfall structures; from seabed activities subject to national jurisdiction; from activities in a designated Area, that is, the seabed, ocean floor and subsoil thereof, beyond the limits of national jurisdiction; from vessels; by dumping; and from or through the atmosphere.¹⁶²

Another UN-run initiative is the Global Programme of Action for the Protection of the Marine Environment and Land-based Activities (GPA).¹⁶³ This effort is a collaboration with the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO-IOC), and the Food and Agriculture Organization of the UN.¹⁶⁴ GPA is “the only global initiative that directly addresses the link between watersheds, coastal waters, and the open ocean.”¹⁶⁵

B. US Laws and Regulations

In addition to enforcing the international conventions listed above, the EPA is charged with ensuring the enforcement of our nation's marine, aquatic, and shore protection and anti-pollution laws briefly described below.

159. Kershaw et al., *supra* note 14, at 29.

160. *Ad Hoc Arbitration Under Annex VII of the United Nations Convention on the Law of the Sea*, PERMANENT CT. OF ARB., http://www.pca-cpa.org/showpage.asp?pag_id=1288 (last visited Mar. 9, 2013).

161. *Id.*

162. Kershaw et al., *supra* note 14, at 29.

163. *Id.* at 28-29.

164. *Id.* at 28.

165. *Id.* at 28-29.

1. Clean Water Act

Originally enacted in 1948 as the Federal Water Pollution Control Act, the Clean Water Act (CWA) came to be in its current form in 1972.¹⁶⁶ The CWA gives the EPA authority to implement pollution control programs, such as wastewater standards, and set water quality standards for all contaminants in surface waters.¹⁶⁷ The EPA uses a permit system for the discharge of any pollutant into navigable waters under the National Pollutant Discharge Elimination System (NPDES).¹⁶⁸

2. Marine Plastic Pollution Research and Control Act

The Marine Plastic Pollution Research and Control Act (MPPRCA) requires the EPA and NOAA “to study the adverse effects of improper disposal of plastics on the environment and on waste disposal, and various methods to reduce or eliminate such adverse effects” and requires an additional collaboration of EPA, NOAA, and the U.S. Coast Guard (USCG) “to assess the feasibility of using volunteer groups in monitoring floatable debris on the Nation's coastlines.”¹⁶⁹ This Act, which amended the Act to Prevent Pollution from Ships (APPS) in 1987, implemented the provisions of MARPOL Annex V relating to garbage and plastics.¹⁷⁰

3. Marine Debris Research, Prevention and Reduction Act

The Marine Debris Research, Prevention and Reduction Act (MDRPA), signed into law by President George W. Bush in 2006, legally established the NOAA Marine Debris Program and set aside \$10 million in funding for NOAA to implement a program of “mapping, identification, impact assessments, removal and prevention activities, research and development of alternatives to gear posing threats to the marine environment, and outreach activities.”¹⁷¹ The program uses NOAA and the USCG to help identify, determine sources of, assess, reduce, and prevent marine debris and its adverse impacts on the marine

166. *Summary of the Clean Water Act*, U.S. ENVTL. PROT. AGENCY, <http://www2.epa.gov/laws-regulations/summary-clean-water-act> (last updated Feb. 24, 2013).

167. *Id.*

168. *Id.*

169. *Marine Plastic Pollution Research and Control Act*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., <http://www.csc.noaa.gov/legislativeatlas/lawDetails.jsp?lawID=730> (last visited Mar. 9, 2013).

170. *Id.*

171. *Marine Debris Research, Prevention, and Reduction Act of 2006*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., <http://marinedebris.noaa.gov/about/act.html> (last visited Feb. 18, 2013); 33 U.S.C. § 1951 (2006).

environment and navigation safety. MDRPRA also reactivates the Interagency Marine Debris Coordinating Committee, which EPA co-chairs with NOAA.¹⁷² The Center of Urban Waters' study of microplastics is an example of a project that received funding from the NOAA Marine Debris Program.¹⁷³

4. Marine Protection, Research, and Sanctuaries Act

Marine Protection, Research, and Sanctuaries Act (MPRSA), also referred to as the Ocean Dumping Act, holds that ocean dumping of materials "that would unreasonably degrade or endanger human health or the marine environment" cannot be done without a permit.¹⁷⁴ The decision to issue the permit is made by the U.S. Army Corps of Engineers¹⁷⁵ using the EPA's criteria.¹⁷⁶

5. Shore Protection Act

The Shore Protection Act (SPA) was created under Title IV of the Ocean Dumping Ban Act of 1988 and concerns the transportation of municipal and commercial wastes in coastal waters in an effort to minimize trash, medical debris, and other harmful materials from being dumped into the ocean as a result of inadequate waste-handling procedures.¹⁷⁷ The Act requires vessels to have a permit to transport this waste, and is regulated by the EPA and the USCG.¹⁷⁸ These entities are responsible "for developing regulations governing the load, securing, offloading, and cleaning up of such wastes from waste sources, reception facilities, and vessels."¹⁷⁹

Treaties, agreements, laws, and regulations only go so far. Not every country in the world has signed off on MARPOL, the London Convention, the London Protocol, or UNCLOS. Even in the U.S., where the EPA governs the broad pollution control and environmental oversight programs, the application of the doctrine of federalism means that not

172. 33 U.S.C. § 1952 (2006).

173. CTR. FOR URBAN WATERS, *supra* note 58.

174. *EPA History: Marine Protection, Research and Sanctuaries Act (Ocean Dumping Act)*, U.S. ENVTL. PROT. AGENCY, <http://www2.epa.gov/aboutepa/epa-history-marine-protection-research-and-sanctuaries-act-ocean-dumping-act> (last visited Mar. 9, 2013).

175. *Id.*

176. *Summary of the Marine Protection, Research, and Sanctuaries Act*, U.S. ENVTL. PROT. AGENCY, <http://www2.epa.gov/laws-regulations/summary-marine-protection-research-and-sanctuaries-act> (last updated Apr. 16, 2013).

177. *Summary of the Shore Protection Act*, U.S. ENVTL. PROT. AGENCY, <http://www2.epa.gov/laws-regulations/summary-shore-protection-act> (last updated Apr. 16, 2013).

178. *Id.*

179. *Id.*

every state is taking the same steps to combat pollution and littering issues. Furthermore, landlocked states might not realize the effects that their practices can have on an ocean hundreds of miles away. In some countries, throwing refuse into a river (that may flow into the ocean) is an everyday occurrence and not given a second thought. There are and will continue to be gaps, internationally and nationally, with our laws and treaties, but that does not have to be the end of the story.

V. EFFICACY OF CURRENT EFFORTS

A. International Efforts

The international community has several suggestions for remedying the problem of ocean pollution. In addition to collaboration among nations, the use of economic instruments, coupled with “concrete actions and effective implementation,” could prove to be useful tools for combating ocean pollution.¹⁸⁰ The UN suggests the following actions: “encouraging the development and use of reception facilities for ship-generated wastes, co-operative action with the fishing sector, consideration of life-cycles of product design to reduce plastic waste, and improvements in waste management practices.”¹⁸¹

The UN Environmental Programme’s Regional Seas Conventions and Action Plans provide a framework for regional coordination and cooperation of 143 participating countries to take comprehensive and specific action to protect shared marine and coastal resources.¹⁸² These eighteen conventions and action plans “could serve as platforms for developing common regional strategies and promoting synergies, mainly at the national level to prevent, reduce and remove marine litter.”¹⁸³ UNEP/GPA and UNEP/RSP’s cooperative effort—the Global Initiative on Marine Litter—has put into place numerous regional marine litter activities.¹⁸⁴ UNEP also collaborated with the NOAA and UNEP¹⁸⁵ for the 5th International Marine Debris Conference, held in 2011, at which there were over 440 participants from thirty-eight countries, from varying backgrounds—government, industry, academia, and concerned

180. Kershaw et al., *supra* note 14, at 28.

181. *Id.*

182. *Regional Seas Conventions and Action Plans*, U.N. ENV’T PROGRAMME, <http://www.unep.org/ecosystemmanagement/Portals/7/Documents/factsheets/RSCAPs%20FactSheet%20web.pdf> (last visited Mar. 11, 2013).

183. Kershaw et al., *supra* note 14, at 29.

184. *Id.*

185. *Id.* at 30.

citizens.¹⁸⁶ Panelists at the conference suggested that one can prevent marine debris, whether from land or sea-based activities, through “a closer and more coordinated working relationship between governments, industry, researchers, civil society and the general public”¹⁸⁷

B. Local/Regional Efforts

1. Tsunami Cleanup

Collaboration after large natural disaster events have proven successful. After the 2011 tsunami in Japan, the United States’ West Coast—specifically British Columbia (BC), Washington, Oregon, and California—commenced collaboration on methods of preparing for and collecting the tsunami debris.¹⁸⁸ After holding several public meetings in April 2012, representatives from state and federal government agencies, local and tribal governments, BC and Oregon emergency managers, non-governmental organizations, and industries, crafted the Washington State Marine Debris Response Plan.¹⁸⁹ Oregon and BC have similar plans in effect.¹⁹⁰ Contributors finalized Washington’s Plan in September 2012 and it will be in effect for two years with the option of renewal if necessary.¹⁹¹ The Plan features a “whole of government” and “whole of community” approach that coordinates support efforts for all Washington shorelines affected by the tsunami debris.¹⁹² The Plan also encourages volunteers to aid in clean up by providing them with litter bags, access to trash bins, and crews from the Washington State Department of Ecology’s Washington Conservation Corp.¹⁹³

2. Plastic Bag Bans and Fees

Municipalities and states have attempted different approaches to combat the issue of plastic bags, including a complete ban on plastic

186. *5th International Marine Debris Conference*, NAT’L OCEANIC AND ATMOSPHERIC ADMIN., <http://marinedebris.noaa.gov/projects/intlmdconf.html> (last visited Mar. 9, 2013).

187. *Id.*

188. CBC NEWS, *supra* note 6.

189. *Washington State Marine Debris Response Plan*, WASH. STATE DEP’T. OF ECOLOGY, (SEPT. 2012), http://marinedebris.wa.gov/docs/responseplan_marinedebris_09182012.pdf.

190. *See State of Oregon Japan Tsunami Marine Debris (JTMD) Plan*, OR. OFFICE OF EMERGENCY MGMT. (Dec. 18, 2012), http://www.oregon.gov/OMD/OEM/public_information/jtmd_plan.pdf; *see also British Columbia Tsunami Debris Management Plan*, TSUNAMI DEBRIS COORDINATING COMM. (Nov. 27, 2012), http://env.gov.bc.ca/epd/tsunami-debris/pdf/BCTsunamiDebrisManagementPlan_Nov2012.pdf.

191. WASH. STATE DEP’T. OF ECOLOGY, *supra* note 189, at 1.

192. *Id.* at 1-2.

193. WASH. STATE DEP’T. OF ECOLOGY, *supra* note 5.

bags and to institute a fee for plastic bags. However, these approaches have had mixed results, and the landscape shifts every day as new ordinances are proposed, implemented, modified, or overturned.

The city of Toronto overturned its plastic bag ban on January 1, 2013.¹⁹⁴ Citizens of Issaquah and Shoreline, Washington, have also supported repeals for plastic bag bans.¹⁹⁵ In contrast, Seattle began its plastic bag ban in July 2012—after a six-month survey of interested parties that yielded few results.¹⁹⁶ The city found that banned bags “have been almost completely eliminated from larger stores” and that a significant number of shoppers brought their own bags.¹⁹⁷

Eight cities in Washington State have banned plastic bags.¹⁹⁸ Other areas across the nation—and not just metropolitan ones—have passed some form of plastic bag bans, including Santa Fe, New Mexico; Los Angeles, San Francisco, Watsonville, and West Hollywood, California; Portland, Oregon; Brookline, Massachusetts; Barrington, Rhode Island; Austin and Laguna Vista, Texas.¹⁹⁹ During the month of April 2013, sixteen bag bans entered the arena in the United States, as will similar bans in Northern Ireland and Pakistan.²⁰⁰

Plastic bag bans, fees, and taxes continuously evolve; additional bans will likely be in effect when this article is published and additional frustrations from some communities will ripen into new legislation or lawsuits.

C. Industry Initiatives

Some of the most tangible results occur at the industry level due to targeted initiatives. When an industry takes responsibility for itself or

194. *Toronto Plastic Bag Ban Decision Reversed*, CBC NEWS (Nov. 28, 2012, 12:58 PM), <http://www.cbc.ca/news/canada/toronto/toronto-plastic-bag-ban-decision-reversed-1.1177902>.

195. See *People's Veto of the Shoreline/Issaquah Bag Ban!*, SAVE OUR CHOICE, <http://www.saveourchoice.us/> (last visited Sept. 22, 2013).

196. SOLID WASTE DIV. SEATTLE PUB. UTILS, *Plastic Carryout Bag Ban*, CITY OF SEATTLE (Jan. 15, 2013), http://www.seattle.gov/util/groups/public/@spu/@conservation/documents/webcontent/01_025116.pdf.

197. *Id.*

198. Ted Duboise, *Seattle's Plastic Bag Ban Success Contagious*, PLASTIC BAG BAN REPORT (Dec. 30, 2012), <http://plasticbagbanreport.com/seattles-plastic-bag-ban-success-contagious/>. At the time of publication, Issaquah, Washington, had not adopted a ban; the article states only seven Washington cities had bans yet.

199. PLASTIC BAG BAN REPORT, <http://plasticbagbanreport.com/category/bans/> (last visited September 21, 2013). Plastic bag bans are gaining speed across the nation. During the month of March, 2013, alone, bag bans in three different locations were implemented, including those in Austin, Texas, Issaquah, Washington, and Mamaroneck, New York, and Portland, Oregon's ban was expanded. *Id.*

200. *Id.*

when businesses take a stand to reduce debris in the ocean, local and international attention can be drawn to the cause. This section, while not exhaustive, introduces examples of non-law-oriented approaches of work being done in hopes of inspiring new ideas.

1. Marine Environment Protection Associations

The shipping sector has established regional Marine Environment Protection Associations (MEPAs) to preserve marine environments via education of shipping employees, port communities, and children.²⁰¹ The MEPA initiative began in Greece in 1982 when seafarers and ship owners declared they would voluntarily eliminate ship-generated marine pollution and enhance safety at sea.²⁰² In June 2006, several of the regional MEPAs also signed INTERMEPA (International Marine Environment Protection Association) into being.²⁰³

2. Method[®]

Method, a manufacturer of cleaning products, commits itself to making its bottles from 100 percent recycled plastic,²⁰⁴ and has created the world's first bottle made with ocean plastic hand-collected from Hawaii's beaches.²⁰⁵ Method created the new bottle to "draw attention to the growing problem of plastic pollution in the ocean and its harmful effects on marine wildlife."²⁰⁶

3. Operation Clean Sweep

Operation Clean Sweep (OCS), an American-British plastic industry collaboration created in 1992 by the Society of the Plastics Industry, aims to reduce the number of plastic pellets found in marine debris.²⁰⁷ When plastic pellet processors handle the pellets responsibly,

201. Kershaw et al., *supra* note 14, at 30.

202. *What is HELMEPA?*, HELLENIC MARINE ENV'T PROT. ASS'N, http://www.helmepa.gr/en/what_is_helmepa.php (last visited Sept. 22, 2013).

203. *The Mission of HELMEPA*, HELLENIC MARINE ENV'T PROT. ASS'N, http://www.helmepa.gr/en/our_goals.php (last visited Sept. 22, 2013).

204. *We Are . . .*, METHOD[®], <http://methodhome.com/methodology/our-story/we-are/> (last visited Mar. 9, 2013).

205. *It's the World's First Bottle Made with Ocean Plastic*, METHOD[®], <http://methodhome.com/ocean-plastic/> (last visited Mar. 9, 2013).

206. Maria Newman, *Clean Your Hands and the Pacific*, N.Y. TIMES (Oct. 10, 2012), http://www.nytimes.com/2012/10/11/garden/method-home-soap-bottles-made-from-ocean-trash.html?_r=0.

207. Kershaw et al., *supra* note 14, at 30; *About SPI*, OPERATION CLEAN SWEEP, <http://www.opcleansweep.org/Overview/About-SPI.html> (last visited Sept. 22, 2013).

pellets do not end up in waterways and oceans, companies' reputations improve, and efficiency is maximized because waste is minimized.²⁰⁸

4. Fishing Industry Initiatives

Fishing for Litter is an initiative of KIMO International, which represents over 150 northern European coastal communities on marine pollution issues.²⁰⁹ Through cooperation between the fishing industry and local government, Fishing for Litter encourages North Sea fishermen to collect and bring to port any litter retrieved in their nets.²¹⁰ The Waste Fishing Gear Buy-Back Project of Korea and South East Asia-Green Fins Project are two other initiatives that encourage a reduction in marine litter.²¹¹

In addition, incentives should be put in place to encourage manufacturers to buy and use recycled plastics to make new products.

D. Non-Governmental Organization (NGO) Initiatives

Cleaning up beaches is more tangible to the average person than trolling deep ocean waters for Styrofoam and bottle caps. But just because the garbage patches are out of sight does not mean that they are any less of an issue. Therefore, NGOs like the ones described below are an instrumental part of figuring out a sustainable solution to the plastics problem.

1. In the Sea

a) Project Kasei

Project Kaisei²¹² has posed one creative solution to the plastics clean-up problem: dredging the ocean for trash, collecting the trash, and turning over the trash to plastic recycling companies that then turn the trash into fuel via pyrolysis.²¹³ Pyrolysis requires heating plastic at high temperatures, turning it into oil.²¹⁴ While ingenious, three factors make

208. *Values of Operation Clean Sweep*, OPERATION CLEAN SWEEP, <http://www.opcleansweep.org/Manual/Value.html> (last visited Sept. 22, 2013).

209. *Learn About Us . . .*, KIMO, <http://www.kimointernational.org/Learnaboutus.aspx> (last visited Sept. 22, 2013).

210. Kershaw et al., *supra* note 14.

211. *Id.* at 30-31.

212. Julia Layton, *Could We Clean Up the Great Pacific Garbage Patch?*, HOWSTUFFWORKS, INC. (Feb. 4, 2010), <http://science.howstuffworks.com/environmental/green-science/clean-up-garbage-patch.htm>.

213. Layton, *supra* note 106.

214. *Id.*

this method impractical.²¹⁵ high costs, distance constraints, and difficulties collecting the trash. Each round of pyrolysis costs \$7 million, which does not include the cost of gathering the trash from distant garbage patches.²¹⁶ Furthermore, photo-degradation makes it difficult to capture the plastic because the sun's rays dry plastic to the point of shattering into tiny particles, which complicates the problem further as activists try to effectively collect miniscule pieces of plastic from the oceans.²¹⁷

Even with criticism, the Project has received worldwide recognition for its efforts in ocean stewardship and the solution sparks optimistic ideas towards cleaning the oceans.²¹⁸

b) Other Organizations Making Waves

Other organizations have made waves—literally. Captain Charles Moore, the discoverer of the Great Pacific Garbage Patch and primary author of *Plastic Ocean*, chartered the Algalita Marine Research Foundation (Algalita) in 1994 with the intent of restoring coastal waters.²¹⁹ Algalita conducts ocean surveys, promotes research projects, and supports the 5 Gyres Initiative in its investigation of the distribution of microplastics and POPs.²²⁰ In 2008, 5 Gyres and Algalita sailed the *Junkcraft*, a sailing vessel made of 15,000 plastic bottles, through the North Pacific Gyre²²¹ to raise awareness about plastic fouling the oceans.²²² In 2010, the *Plastiki*, a 60-foot catamaran made up of 12,500 plastic bottles and other PET products, sailed from San Francisco to Sydney to raise awareness about plastics in the ocean.²²³

2. On the Shore

a) International Coastal Cleanup

Trash constantly washes onto beaches, catalyzing the need for constant beach cleanup. Fortunately, volunteers willingly comb for trash instead of seashells. Ocean Conservancy's volunteers have cleaned

215. *Id.*

216. *Id.*

217. *Id.*

218. See *Kaisei History*, PROJECT KASEI, http://www.projectkaisei.org/kaisei_history.aspx (last visited Apr. 6, 2013).

219. MOORE, *supra* note 1, at 6.

220. Kershaw et al., *supra* note 14, at 32.

221. *Id.*

222. JUNKRAFT, <http://www.junkraft.com/home.html> (last visited Mar. 10, 2013).

223. Kershaw et al., *supra* note 14, at 31-32.

international shorelines for more than a quarter century as part of International Coastal Cleanup.²²⁴ In fact, since the beginning of its cleanups, Ocean Conservancy's volunteers have collected more than 144,606,491 pounds of trash from beaches across the world.²²⁵ According to the 2012 cleanup data, close to 600,000 volunteers scoured 20,776 miles of shoreline and collected 9,184,428 pounds of trash.²²⁶ The top five common items were cigarettes, made using cellulose acetate fibers (a type of plastic that degrades very slowly); caps and lids; plastic beverage bottles; plastic bags; and food wrappers and containers.²²⁷

b) Clean Up the World

Clean Up the World, another volunteer-based initiative, began in 1993 with the goal of encouraging communities to make a positive difference for the environment.²²⁸ An estimated 35 million volunteers in 130 countries participate in community-based projects to conserve the environment by bringing together businesses, community groups, schools, governments, and individuals.²²⁹ While groups like these make strides every year in cleaning our ocean shores, plastic debris continues to be a perpetual problem requiring constant attention.

VI. CONCLUSION

The ocean suffers the consequences of the cost of convenience for humanity. When we treat the ocean as a trash dump, whether directly or indirectly, intentionally or unintentionally, we do so at our own peril. Even if we cannot directly see the effects of plastics, the reality is that plastics have become an invasive species. Progress has been made in the last few decades by educating communities about recycling, sustainability, and green living. However, our reliance on use and disposal of plastics has also increased. One can hardly imagine a life

224. *Clean Beaches, Clean Water*, OCEAN CONSERVANCY, <http://www.oceanconservancy.org/healthy-ocean/clean-beaches-clean-water/> (last visited Mar. 10, 2013).

225. *About Ocean Conservancy*, OCEAN CONSERVANCY, <http://www.oceanconservancy.org/who-we-are/> (last visited Mar. 10, 2013).

226. *International Coastal Cleanup 2012 Data Release*, OCEAN CONSERVANCY, <http://www.oceanconservancy.org/our-work/marine-debris/check-out-our-latest-trash.html> (last visited Mar. 10, 2013).

227. Marty Mulvihill and Wendy Hessler, *Synopsis of Accelerated Degradation of Cellulose Acetate Cigarette Filters Using Controlled-Release Acid Catalysis*, ENV'T'L. HEALTH SCIENCES (2012), <http://www.environmentalhealthnews.org/ehs/newscience/2012/06/2012-0725-biodegradable-cigarette-filters>.

228. Kershaw et al., *supra* note 14, at 31-32.

229. *About Clean Up the World*, CLEAN UP THE WORLD, <http://www.cleanuptheworld.org/en/About/about-cuw.html> (last visited Mar. 9, 2013).

without plastics, but in actuality, plastics have only been a part of the human lifestyle for a few decades. Herein lies the difficult question: With plastic being part of our story for such a short while, yet taking such a toll on our planet, what can be done?

If we cannot clean up the oceans with current technology, we must stop the flow of trash entering them. There are many treaties, acts, ordinances, promises, projects, and studies in the name of clean oceans. These are a good start but other steps should be taken to reverse the trend.

As highlighted, industries tend to make large impacts. For instance, the plastics industry has its own initiative (OCS) to keep pellets out of seas, and the cosmetics and soap industry has taken steps to find alternatives to storm-drain filling and sediment-causing microscrubbers. Consumers could insist that manufacturers lessen the amount of packaging for products; request that cigarette manufacturers return to a design that does not include plastic fibers in filters; and demand that biodegradable plastics replace petroleum-based plastics.

At a local level, more cities could tax or ban plastic bags. Even if a locale decides that it does not want to eliminate bags, cities with facilities that cannot handle plastic bags should notify its citizens so that the bags can be taken to specialized receptacles—such as outside grocery stores. Further, while advances have been made in Seattle and other places in the country, previously existing bags need to be collected and recycled.

Low-recycling or no-recycling areas must create more incentives to recycle. Even if a consumer does not personally scoop plastic out of the ocean or make demands from governments or industries, one can advance the mission of reducing ocean plastic pollution by acting as a prudent consumer. For instance, consumers should scrutinize products when purchasing cosmetics containing microscrubbers²³⁰ and opt for face wash that uses ground apricot seeds or other natural products rather than perfect plastic spheres. Consumers can buy less, buy in bulk, and buy recyclable products.²³¹ Consumers can seek products that are closest to their natural form, rather than packaged within packages. Consumers can use reusable shopping bags. Consumers can put cigarette butts with plastic fibers in the trash, rather than leaving them on the ground to be washed into storm drains (or better yet, stop smoking altogether.).

None of these efforts are *the* right one, nor completely solves the problem. But, a combination of international, regional, local, and

230. Rosner, *supra* note 109.

231. ALGALITA MARINE RESEARCH FOUND., *supra* note 80.

personal commitments are all needed to save the oceans from being strangled and invaded by plastics.